RFID based Advanced Shopping Trolley for Super Market

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Manikandan T*, Mohammed Aejaz M.A, Nithin Krishna N.M, Mohan Kumar A.P, Manigandan R
Rajalakshmi Engineering College, Chennai
***Corresponding author: E-Mail: Mani_stuff@yahoo.co.in**

ABSTRACT

Despite the presence of E-commerce people tend to buy many products only in supermarkets and malls for the sake of their own satisfaction. Among the difficulties faced by the customers one difficulty is to follow queue through the billing process. Though their intent is just to buy one or two products, waiting to bill products consumes time and also inconvenient these days as people live in a busy environment. As per our survey money and average time spent on each customer is high especially in over-crowded supermarkets. The shopkeepers are ready to welcome any smart machines that automate the billing process to reduce manpower and time consumed for that process. The main aim is to satisfy the customer and also reduce the time spent on the billing process which is to complete the billing process in the trolley rather than waiting in a queue even for one or two products. The customers have to add the products after a short scan in trolley and when done the finalized amount will be displayed in the trolley. Customer could either pay their bill by their ATM cards or through pre-recharged customer card provided by the shop. We have ensured security for preventing theft and also facilitated for users who unknowingly drop their projects into trolley by cautioning them.

Our ultimate motto is to mitigate the time consumption in purchase by getting rid of queue ensuring customer's comfort and shrinking the tediousness of barcode scanning and eliminating waging of billers, thereby accomplishing both customer and shopkeeper demands.

KEY WORDS: Shopping trolley, Super market, RFID, ATMEGA32.

1. INTRODUCTION

We see these days RFID's are widespread and taking role in many advanced projects due to its fast and effective response. RFID are generally tags that are used for unique identification of products by using radio waves. These RFID's offer more advantages over conventional Barcodes as they have a major drawback which is Line of sight technology and also these barcode tags have constraints in its durability whereas the RFID's tags are more durable and able to read/write data which could even be encrypted. These tags could hold plenty of data like products name, price, size, weight and other information using their identification number.

By implementing this RFID technology for unique representation of each product in a market shopping is done more easily. This could be done by having Shopping trolley installed with an RFID reader to scan each product and load it which is controlled by a micro controller. Every new customer will be provided with a unique RFID based customer card which will hold all necessary information about the customer and also amount he recharged before. As an additional feature IR sensors are included to warn the user if they accidentally drop products into cart without scanning. As a concern to security, the cart is provided with Sliding door which is run by a DC motor and it opens for every scan to let products in. When the customer is done shopping he could pay his final bill by deducting money from the customer card or even through ATM cards.

Our concept satiates the expectation of customers whose basic demand is to ease the way of purchase. By regulating the RFID based shopping cart, one could easily bill the products themselves without bothering the presence of workers in shop as details of product are readily available and displayed in the cart. This outcome of the project will not only facilitate the customers but also the shop owners by eliminating the cashiers and money spent on them.

Literature Survey: As per our knowledge only few papers were found in the literature for the automated shopping trolley for super market using RFID.

The automated shopping trolley for supermarket billing system implemented by Sainath (2014), exploited barcode for billing of products, where customer scans the product using barcode technology. The bill will be forwarded to the central billing system where customer will pay them by showing unique id. The limitation of barcode scanning requires line of sight for scanning and it should be fixed within its boundary.

Cash register lines optimization system using RFID technology by Budic (2014), developed a system for shopping using RFID. The RFID is employed for scanning products and the information is stored in the database which could be paid online or in a central bill. It also uses web application to maintain entire shopping details. It requires maintenance of web application server. No necessary steps have been taken for the products that are accidentally dropped into the trolley by the customer.

IOT based intelligent trolley for shopping mall by Dhavale Shraddha (2016), applied RFID technology for billing during purchase in shopping malls and IOT is used for bill management by means of ESP module. The payment details will be sent to the server by which central billing unit will deal with customer's payment. The ESP module will be working as a short distance Wi-Fi chip for wireless communication. But there is a drawback which

includes constraints such as distance and interference. Server will be busy if customers are high and internet connectivity should be stable for finishing the process.

Smart shopping trolley using RFID by Komal Ambekar (2015), implemented smart way of shopping trolley with RFID and ZigBee by which bill is generated by scan of products in the reader and bill transmitted to central billing department by which bill can be paid at the counter which is a major difficulty for the customer.

Smart shopping cart with customer oriented service by Hsin-Han Chiang (2016), accomplished a concept of automated shopping trolley with automated billing where they used face recognition for customer authentication. It is not a simple process as face recognition of customers during shopping hours will not be easy and accurate as malls can be crowded. Many errors are possible while using recognition for authentication.

Smart RFID based Interactive Kiosk Cart using wireless sensor node by Narayana Swamy (2016), applied RFID for automated shopping. They used dedicated website for billing maintenance and for user interaction. Every user with the unique id access the webserver for the bill payment and invoice information. Internet service is mandatory in this type of service. So the process may fail due to internet instability and server error problems may also occur due to high load.

Shopping and automatic billing using RFID technology by Vinutha (2014), has an automatic billing with server end. This scans products by radio frequency identification and then the bill is generated at the server end which is then communicated to the customer. This requires server maintenance and internet connectivity both for the customer and shopkeeper.

Smart shopping cart with automatic billing and Bluetooth proposed by Prateek Aryan (2014), is a process where billing is done in a trolley and transferred to the android mobile of the user via Bluetooth. Every customer can't be expected to have a smart phone and Bluetooth can have connectivity issues and range is less.

Automated smart trolley with smart billing using Arduino by Suganya (2016), developed a model of automatic shopping with Arduino and an android application which again requires network to be connected always. Android operated mobiles may or may not be present with every customer. Network instability leads to delay in the billing.

RFID enabled smart billing system by Vanitha Sheeba and Brindha Rajkumari (2015), did a concept model consists of RFID and ZigBee which transmits generated bill to the server and then the bill is collected by the worker in the bill counter by identifying customers. But this again will lead to queue for billing since only bill generation is alone automated by scanning using RFID.

Our idea has a stable and simple billing process of making payment in the trolley itself. Since it avoids the requirement of Wi-Fi, ZigBee, ESP module and others which is used above. It can be paid using customer card or the ATM card. Above concepts doesn't ensure security and theft of products either intentionally or accidentally. We used door by which products cannot be dropped without scanning by the customer. We also have used separate IR sensor to avoid the accidental dropping of products. To make it more effective we used code logic which correlates the IR count and RF count in the microcontroller. For security we installed password authentication feature by which each customer possesses unique card with unique password. Barcode technology is replaced by RFID in our system which gives fast and accurate scanning of products.

2. PROPOSED METHODOLOGY

The proposed methodology is the automated billing for a customer during shopping primarily based on RFID supported with other simple technologies. In shopping malls or supermarkets, the products are provided with RFID tags instead of barcodes. The shopping trolleys include the setup containing RFID reader, IR sensor, door with motor, relay, GSM module, LED, CLCD, Keypad and a push button. Smart RFID cards are given to customers for their unique identification.

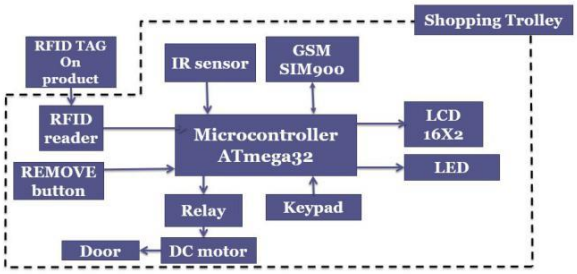

Fig.1. Block Diagram of the proposed model

Micro-controller: ATMEGA32 is used where it is an eight bit AVR based RISC machine. It operates at 4.5 to 5.5volts DC. It is a forty pin PDIP with thirty-two programmable i/o lines. It consists of non-volatile 32kB of in-system self-programmable flash, 1024B of EEPROM and 2kB internal SRAM. It has features such as timers, A/D converters, PWM and serial interface. Processing speed ranges 0 to 16MHz. So it stores the instructions and process accordingly. Purpose of microcontroller is to control the whole process through the instructions stored.

RFID tags: These tags comprise of a microchip for storage of its unique number and a coil which acts as an antenna for radiating its stored data. It may or may not have a battery depending upon its type either active or passive respectively. Passive tags are used which doesn't have a battery. As soon as the tag comes in the RFID reader coverage range the Reader emits RF signals which gives power to passive tags and it re-emits the signal with data to the reader. Purpose of RFID tags is to uniquely identify products.

RFID reader: EM-18 is used which operates at 5volts DC and less than 50mA. The frequency at which it works in 125kHz. It can cover a distance of 10cm. It continuously emits RF signals throughout its range and whenever an RFID tag is inside its distance coverage it retrieves the information stored in the tag. Purpose of RFID reader is to retrieve the product information from their RFID tags.

Infra-Red sensor: It is an object detection sensor. It operates in frequency range of 300GHz to 400THz and wavelength range of 700nm to 1400nm. It has a photodiode and an LED. LED as usual emits light in IR range to a certain distance depending upon the manufacturing parameters and whenever there is a reflection of emitted light due to an obstacle, it gets sensed by the photodiode. Purpose of IR sensor is to count the objects entering the trolley for preventing misplacement or theft.

CLCD: It is a Character Liquid Crystal Display. It consists of two rows and sixteen columns. Each element in a row or a column can display a character which in turn has eight rows and five columns known as pixel. It has sixteen pins where data is fed through eight pins. The supply voltage should be 5volts. It has registers to ensure proper functioning namely data and command. Data register takes ASCII (American Standard Code for Information Interchange) values for characters to be displayed. Command register takes values for making functional adjustments such as backlight contrast, cursor position etc. Purpose of CLCD is for displaying information to the customer such as welcome note, product catalogue, product details, invoice etc.

DC motor: A DC geared motor is used which has an operating voltage of 12volts and 0.5A. The frequency of rotation will be around 150 to 200rpm (revolutions per minute). Geared motor indicates the extra ring with teeth like projections attached to the shaft of the motor to ensure uniform speed throughout the rotation of the rotor. Purpose of DC geared motor is for proper opening and closing of the trolley door.

Motor driver: Motor driver is a setup which has two input supply and a ground. One supply for circuit and other to pass to the motor. We used driver circuit which is capable of controlling motor rated up to 12volts. Purpose of motor driver circuit is to control the motor.

Keypad: Numeric keypad is used considered as a matrix which has four rows and 3 columns with numbers '0' to '9' and symbols asterisk '*' and hash '#'. Each row and column is connected with a wire whereas it consists of totally seven wires. The columns are always kept high and rows are kept low. So whenever a key is pressed row and column at that position gets in contact which in turn makes the row high so the corresponding element is detected depending on the row and column index. Purpose of numeric keypad is for user inputs such as password entry, selecting options such as viewing product catalogue, finish shopping and generate invoice.

GSM module: GSM – Global System for Mobile communication. GSM sim900A type module is used which has a supply voltage in the range of 3.4 to 4.4volts. It can operate in four bands of frequency (850/900/1800/1900 MHz). GSM mostly utilizes 850 and 900 MHz frequency. It has the ability to transmit information in the form of voice (call), text (Short Message Service) and data (GPRS – General Packet Radio Service). Purpose of GSM is for sending alert for unauthorized usage and invoice in the form of text as an SMS to corresponding user.

Push button: A push button generally resembles a switch which will produce high output when pressed and low when it is released. Purpose of push button is to enable remove operation from the trolley.

LED: A Light Emitting Diode emits light on supply voltage of around 5volts. It is a type of p-n junction diode where it emits light due to recombination of holes and electrons when biased. Purpose of a LED is to caution when product count between RF and IR varies.

Power Adapter: The power adaptor is used for dc supply to the setup. It acts a rectifier where it takes input of about 240volts AC and 30 amps and gives output of 12volts DC and 1 amp which will be suitable to our setup. Purpose of power adapter is to provide a steady DC supply from an AC power source.

The process is a combination of modules whereas customer authentication is the one with which it gets started. So first customer will be provided with a smart card which is RFID enabled. To start shopping customer should take trolley and assign it to him by scanning his smart card across the RFID reader present in the trolley. After a proper scan he will be asked to enter his password for authentication in the CLCD. Thereby if he enters a correct password using keypad then he can start shopping or else if he fails to enter a correct password for three attempts then the card gets locked and an OTP (One Time Password) is sent to customers registered mobile number using GSM module. This helps in preventing fraudulent usage of smart cards. After successful authentication customer details are displayed along with their total balance available in their card and then he/she is allowed to start shopping. There is an option for product catalogue by which customer can press the asterisk '*' in the keypad which in turn displays the available products and their corresponding shelves in CLCD. Customer starts shopping and he scans products with RFID tag in the RFID reader which initiates motor by means of relay for opening the door of the trolley

and the scanned product is dropped into the trolley. In the meantime, CLCD displays the details of the products and total cost accumulated in the purchase. During this process IR sensor works backend in parallel mode which identifies the count of products which are being dropped. This helps in the cross verification of number of products scanned and number of products dropped in the trolley. If the count of scanned products and count of dropped products mismatch thereby arousing a caution by means of a light emitting diode. This helps to avoid dropping products accidentally which are not scanned and in preventing the theft. Thus the process repeats until customer finishes shopping. When a customer needs to remove a product, push button should be pressed which initiates remove operation such that door opens and product is removed by rescanning satisfying the condition that the scanned product id should be already present in the purchased list. During this remove process the cost of product removed is subtracted from the total cost and CLCD displays the updated cost. Remove process ends as soon as the push button is released. After customer finished shopping he need to press hash '#' in the keypad then the total bill is displayed in the CLCD which can be paid through the available balance in the smart card or using debit or credit cards. An invoice of the paid bill will be sent to the customer mobile as a text message using GSM module. After successful payment the door opens and the customer can take away the products purchased with ease.

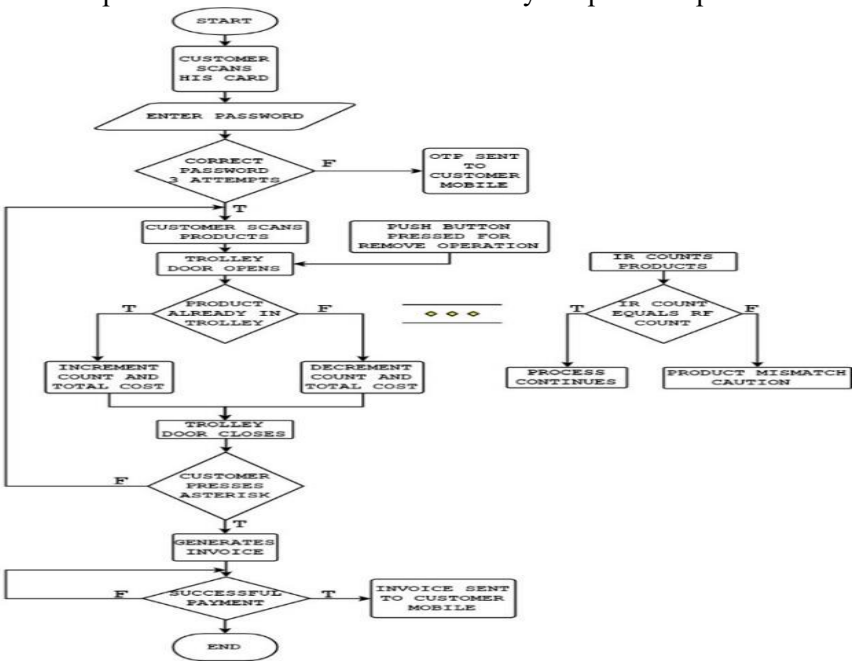

Fig.2. Process Flow

3. RESULTS AND DISCUSSION

The proposal finally resulted in an effective outcome where RFID technology replaced barcode due to its drawback where barcode requires the line of sight and should be placed in its exact boundary while scanning, but RFID's only constraint to be considered is its distance coverage. RFID tags are more durable than the barcode which damages due to temperature, water, physical tear etc. This ensures the process of scanning easy and precise. Then the password authentication process aids in avoiding the illegal usage of smart cards and also prevents data sniffing. The door in the trolley doesn't open until a product is scanned which doesn't allow to place a product inside a trolley that is not scanned. The tracking of count of products using IR sensor placed inside the trolley aids in protecting the theft of the products and taking away products that are not billed unintentionally. Removing a product can also be done perfectly with the push button which guarantees customer that products can be removed whenever he changes his mind. The product catalogue display feature enables the customer for easy search of products without any difficulties. The GSM module sends time to time information to the customer mobile for flawless intimation about his shopping activities. The results show that the proposed model is fine to be implemented in current shopping environments.

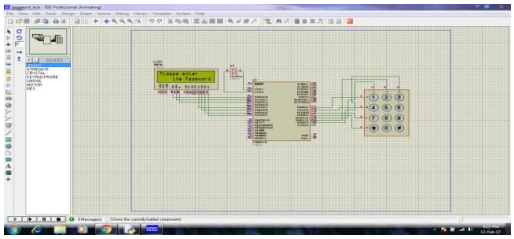

Fig.3. Simulation of customer authentication

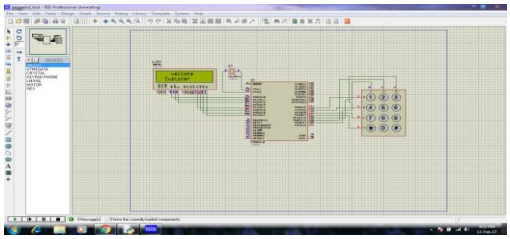

Fig.4. Simulation of welcome module

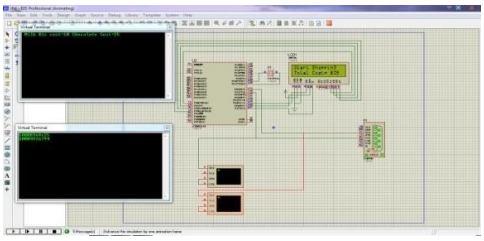

Fig.5. Simulation of Product scanning

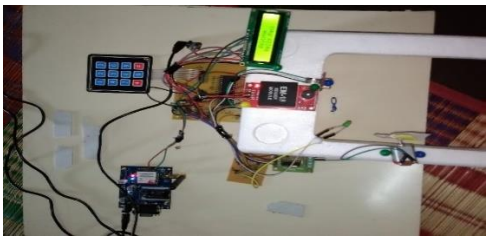

Fig.6. Hardware output for Welcome note

Fig.7. Hardware output for Authentication

Fig.8. Hardware output for wrong password

Fig.9. Hardware output for Product catalogue

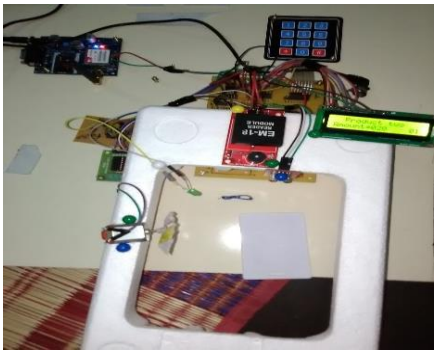

Fig.10. Hardware output for Products scan

Fig.11. Hardware output for Remove operation

Fig.12. Hardware output for final invoice

4. CONCLUSION

According to customer's point of view our project has redefined the way of purchasing. Evidently RFID has outsmarted barcodes by its accuracy, fast response and durability. Our concept has erased the tradition of customer relying on the shopkeeper for acquiring information about products. Billing is completely avoided which in turn saves time for the customer and makes process easy for shopkeeper. It avoids queue for customer since billing is completed in the trolley. It reduces one third of the overall investment of the shopkeeper for billing department. Thus the model allows better shopping experience using improved technology which can be handled by any common man who just knows to read and write things.

Future advancement is to use enhanced RFID readers that operate in high frequency which can read multiple tags simultaneously. Mobile application can be developed to avoid smart card and GSM. Inventory management can be incorporated using IOT which in turn helps in automation of stock management.

REFERENCES

Ashmeet Kaur, Avni Garg, Abhishek Verma, Akshay Bansal, Arvinder Singh, Arduino Based Smart Cart, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 2 (12), 2013.

Budic D, Martinovic Z, Simunic D, Cash register lines optimization system using RFID technology, IEEE Explore, 2014.

Dhavale Shraddha D, Dhokane Trupti J, Shinde Priyanka S, IOT Based Intelligent Trolley for Shopping Mall, IJEDR, 2016.

Galande Jayshree, Rutuja Gholap, Preeti Yadav, RFID Based Automatic Billing Trolley, International Journal of Emerging Technology and Advanced Engineering, 4 (3), 2014.

Hsin-Han Chiang, Wan-Ting You, Shu-Hsuan Lin, Wei-Chih Shih, Yu-Te Liao, Jin-Shyan Lee, and Yen-Lin Chen, Development of Smart Shopping Carts with Customer-Oriented Service, 2016 International Conference on System Science and Engineering (ICSSE) National Chi Nan University, Taiwan, 2016.

Kalyani Dawkhar, Shraddha Dhomase, Samruddhi Mahabaleshwarkar, Electronic Shopping Cart for Effective Shopping based on RFID, International journal of innovative research in electrical, electronics, instrumentation and management engineering, 3 (1), 2015.

Komal Ambekar, Vinayak Dhole, Supriya Sharma, Tushar Wadekar, Smart Shopping Trolley Using RFID, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 4 (10), 2015.

Narayana Swamy J.C, Seshachalam D, Saleem Ulla Shariff, Smart RFID based Interactive Kiosk Cart using wireless sensor node, 2016 International Conference on Computational Systems and Information Systems for Sustainable Solutions, 2016.

Prateek Aryan, Priya Pise, Sandip Tamhane, Smart Shopping Cart with Automatic Billing System through RFID and Bluetooth, IJETCS, 2014.

Raju Kumar, Gopalakrishna K, Ramesha K, Intelligent Shopping Cart, International Journal of Engineering Science and Innovative Technology, 2 (4), 2013.

Rupali Sawant, Kripa Krishnan, Shweta Bhokre, Priyanka Bhosale, The RFID Based Smart Shopping Cart, International Journal of Engineering Research and General Science, 3 (2), 2015.

Saad S.S and Nakad Z.S, A standalone RFID indoor positioning system using passive tags, IEEE Trans. Ind. Electron., 58 (5), 2011, 1961 -1970.

Sainath S, Surender K, Vikram Arvind V, Thangakumar J, Automated Shopping Trolley for Super Market Billing System, International Conference on Communication, Computing and Information Technology, 2014.

Sales J, Marti J.V, Marin R, Cervera E, and Sanz P.J, Compa Rob: The shopping cart assistance robot, Int. J. Distributed Sensors Networks, 2016.

Satish Kamble, Sachin Meshram, Rahul Thokal, Roshan Gakre, Developing a Multitasking Shopping Trolley Based On RFID Technology, International Journal of Soft Computing and Engineering, 3 (6), 2014.

Suganya R, Swarnavalli N, Vismitha S, Rajathi G M, Automated Smart Trolley with Smart Billing using Arduino, IJRASET, 2016.

Suryaprasad J, Praveen Kumar B.O, Roopa D, Arjun A.K, A Novel Low-Cost Intelligent Shopping Cart, Proceedings of the 2nd IEEE International Conference on Networked Embedded Systems for Enterprise Applications, NESEA 2011, Perth, Australia, 2011.

Vanitha Sheba M, and Brintha Rajakumari, RFID Enabled Smart Billing System, Indian Journal of Science and Technology, 8 (32), 2015.

Vinutha M L, Harshitha P Bale, Sushma R, Suchitra M, Shopping and Automatic Billing Using RFID Technology, IJECET, 2014.

Vrinda Gupta, Niharika Garg, Analytical Model for Automating Purchases using RFID- enabled Shelf and Cart, International Journal of Information and Computation Technology, 4, 2014.